COST EFFECTIVE VV&A: GET CREDIT FOR WHAT YOU'RE ALREADY DOING

Michelle L. Kilikauskas
Joint Accreditation Support Activity
Naval Air Warfare Center
Weapons Division
1 Administration Circle
China Lake, CA 93555
michelle.kilikauskas@navy.mil

David H. Hall
SURVICE Engineering Company
900E N. Heritage Drive Suite 1
Ridgecrest, CA 93555

dave.hall@survice.com

KEYWORDS

Accreditation, Documentation, Verification, Validation

ABSTRACT

The vast majority of software engineers are conscientious professionals who work hard to convince themselves that their software does the right thing and works correctly. But they almost never write down what they do so that they can convince someone else. The work they do is, in essence, verification and validation. Part of the problem is that developers often don't think of what they do as "V&V", they may or may not be focused on the M&S application requirements, and if it's not documented then they can't get credit for it, anyway.

This paper describes a cost-effective VV&A approach centered on the capability, accuracy and usability of M&S. This approach focuses V&V activities on accreditation requirements by formalizing an intended use statement by the ultimate M&S user. The approach also facilitates making best use of activities that already are ongoing during the development of the software. We identify some useful tips for low cost informal documentation of V&V information required to support an accreditation.

INTRODUCTION

Many program managers in the defense acquisition community think that verification, validation and accreditation (VV&A) of models and simulations (M&S) is too hard, costs too much and takes too long. Most of the time they are thinking of extensive Independent Verification and Validation (IV&V) efforts; the IV&V practitioner rightly wants to make sure that the M&S he or she supports have a well documented, disciplined process of V&V applied to them.

However, in our experience most M&S developers are already doing a lot of the right things in V&V, but: (1) those same developers don't see much of what they're doing as "V&V", so they under-report what they do. (2) Most developers don't write down what they did in any retrievable fashion, or they leave out key pieces of information. This is exacerbated by the extensive use of personal computers, which has nearly eliminated the use of engineering notebooks, and creative people often detest documenting anyway. (3) Pressure to produce a product on time and within budget often means that if program managers fund any V&V activities, funding for documenting them falls off the table.

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
2002		**00-00-2002 to 00-00-2002**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Cost Effective VV&A: Get Credit for What You're Already Doing	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Joint Accreditation Support Activity,Naval Air Warfare Center,Weapons Division, 1 Administration Circle,China Lake,CA,93555**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			
unclassified	**unclassified**	**unclassified**	**Same as Report (SAR)**	**6**	

We have helped a number of acquisition programs to develop a cost-effective VV&A approach, using the results of work that they were already doing. All of these efforts did require some additional effort, but we were in every case able to leverage previous work extensively. Many of these customers were doing considerable V&V, but it was not focused on their application and it wasn't being documented. We have helped them to focus their efforts on the requirements of their application, and to document their ongoing V&V efforts in ways that minimized any additional effort while capturing their critical V&V results.

ACCREDITATION PROCESS

Figure 1 illustrates the process that the Joint Accreditation Support Activity (JASA) uses to support a program's accreditation of models and simulations (and sometimes, physical simulators).

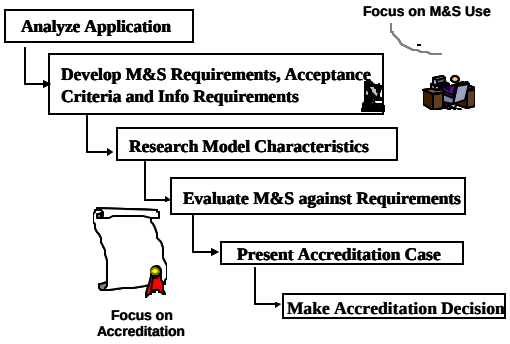

Figure 1. Accreditation Process

The nature, scope and depth of information necessary to accredit a simulation depends partly on what the simulation is being used for and partly on how much risk is associated with its use for that purpose. Accreditation is a statement of confidence in the credibility of the simulation for a specific application (it is not a statement of general credibility for any application whatsoever.)

M&S requirements and acceptance criteria are determined by a combination of application analysis and risk analysis. *Application analysis, or use analysis* establishes the specifics of how the simulation will be used, and which simulation functions and outputs are important. *Risk analysis* establishes the level of credibility required, and which aspects of simulation credibility are essential to accreditation. From those two activities we can determine V&V requirements. By comparing ongoing V&V activities with the requirements for V&V, we can develop a tailored VV&A plan specific to the application. When the planned VV&A activities are completed, an accreditation recommendation can be made to the Accreditation Authority, who makes the final accreditation decision. A key element of the process is to determine any limitations on the use of the simulation based on the documented results that are available, and any proposed workarounds in areas where the simulation may not be acceptable. Ultimately, the accreditation provides an assessment of the risks of using the simulation for the application.

The key to making this process cost-effective is to focus the required activities where they most make sense. In the first phases of the process, the focus needs to be on the intended use of the simulation; in fact, the entire purpose of the application analysis and Intended Use Statement is to develop M&S requirements and acceptance criteria for the specific use; these will be the criteria against which the M&S will be judged. In the last phases, the focus is on accreditation: that is, does the accreditation authority have enough information to make a decision that the M&S meets those acceptance criteria?

And that is where the rubber meets the road. Too often programs have done considerable work to ensure that their simulation has the capability, accuracy and usability they require, but they have not made sure that their work has been documented. So they did the work, but they don't get the credit, thus running the risk of not being accredited by the ultimate user.

What JASA has done for a number of customers is to review their VV&A plans, results and especially their documentation of VV&A activities. We have consistently seen that programs are conscientiously tracking the credibility of their M&S tools. However, they have almost uniformly not captured that work in documents, or even informally in lab notes, viewgraph presentations, etc.

We have found that it often is not necessary to expend resources formally documenting VV&A results. Informal documentation is often sufficient for the purpose of providing evidence of M&S credibility, as long as it is readily retrievable and traceable back to the M&S version used and the personnel involved. The following are some tips on how to make those informal records meaningful to an accreditation assessment.

INCREASING THE VALUE OF INFORMAL RECORDS

Based on our experience with a number of programs, we have come up with some simple ways to increase the value of any existing information you may have for supporting an accreditation decision, as well as some thoughts on how to better capitalize on planned activities in the future. These ideas have been used successfully by a number of DOD acquisition programs over the last several years.

Ideas for Increasing the Value of the Existing Record

1. As a guiding principle, focus on content rather than aesthetics. With a limited amount of time, it is much more important to write the information down clearly in a place where it can be retrieved easily than it is to get fancy. Write information by hand onto meeting agendas or onto a hardcopy of the viewgraphs from meetings.

2. Gather technical resume sheets for each person on the development team and keep it with the team records. Include information on the technical qualifications of each person (training, experience) as well as their major areas of emphasis or responsibility in developing the simulation. We suggest you also include information on people who are referenced in your files or working notes. The qualifications of the team members help to build confidence in the product.

3. Look through the briefings you have on hand, find incomplete references and fill in the missing information. Write the information on a hardcopy of the viewgraph and keep it in the program files. For example, if there is a reference to an author (Skolnik, for example), write down the title of the book or paper or internal memo and the date. Noting the pages from that reference that contain the relevant formulations would be a good practice. Particularly for internal memos, some hint on where to get a copy of the reference would be helpful. If you have the document, make a copy of the cover or title page and the relevant sections and put it in the file with the viewgraphs.

4. For data plots which contained more than one trace, include a key which indicates which line is what. If your team uses a consistent convention, (old version is solid

line and new version is dotted line, for example) a note at the beginning of the record that describes the plotting conventions would be useful to outside observers.

5. Also, for plots in your existing record, go back and make some comments directly on the plots about what the plot is showing, your analysis of what the plot means, and any inferences you can make about the implications for credibility or usefulness of the simulation. If the plots show good correlation between simulation predictions and field data or expert opinion, or the plot indicates a problem that you followed up and corrected, this is important evidence of the correctness of the simulation that you should get credit for. But, you don't get credit for good correlation if people don't know what they're looking at.

6. Look over the records and jot on the viewgraphs which version of the simulation the information is related to and the approximate date the memo or viewgraph package or whatever was generated.

7. Look over the records and jot on the viewgraphs which version of the system hardware components the module is related to (for example, is a model of the Inertial Measurement Unit (IMU) generic or is it tied to a particular version of the real IMU?). You should describe the hardware component in enough detail to uniquely identify it: serial number, delivery date, label, etc.

8. Also, jot down enough about test cases (initial conditions, test file name, etc.) that the plot is meaningful to someone else.

Almost Painless Ways to Increase the Value of the Records You Generate from Here On Out

1. Put the title, date, point of contact, and contact info (telephone, email address) on the cover of any viewgraph presentations or reports.

2. Document the version of the code to which the presentation applied and the version of any hardware components whose behavior or characteristics are reflected in the code.

3. Take a moment during informal review sessions to jot down the essence of the discussion about the presentation. Were there concerns about any of the charts shown? Questions? Is there anything in the plots that doesn't look right that needs follow-up? Was there consensus that the design looked good, or the plots matched what you expected, or there was good correlation between the simulation predictions and the reference data (test data, intelligence estimates, whatever)? If it looks good, make a comment to that effect and initial and date it. We suggest that the others in the review also initial the hardcopy of the viewgraph. If something looks strange, mark it on the hardcopy and jot down who is going to follow up. Keep a key in your records that has a list of team members' clearly legible names and a sample of each person's initials. For more information on conducting effective reviews, see also (Kilikauskas, 2002)[*].

4. Require an assumptions and caveats slide in presentations on design or results. It just takes a moment to put it down on a slide, but

[*] Kilikauskas, M.L. 2002. "Conducting An Effective Expert Review", Briefing at Mini-MORS Workshop 2: Test & Evaluation, Modeling & Simulation and VV&A, Kirtland AFB, NM (October)

it may be impossible to recreate the information later.

5. Keep a logbook of team meetings. Jot down notes of who was there, topics of discussion, activities (peer review of design fixes for the IMU, etc.) major findings, and action items. This helps establish a pattern of informal review over time.

6. Software engineers generally show day-to-day results to each other informally for a sanity check outside of a review meeting. This is a form of peer review. When one person looks over someone else's design or code or output, have them jot their comments on the paper and date and initial it. This may be particularly helpful for work done by engineers with less experience. Outside observers generally feel better about work done by less experienced team members if they see evidence that colleagues with more experience have been giving them a hand.

7. In briefings about module design or results, include a slide which summarizes who has who looked at the design or output plots so far, their comments/conclusions, and why their opinion means anything. This helps to build evidence of checks during the development process and preserves any comments or conclusions.

8. Require that software engineers record the source of the algorithms and data they use in developing individual software modules. If the engineer modified the data after it was received from the original source, record how the data were changed and why. This should be standard information in a viewgraph presentation on the design or modification of a software module. Putting this information in the code as comments ensures that the data source and modification and transformation information stays with the code.

9. In any briefings on changes to a baseline simulation, a slide or two on the implications for simulation use would be a very nice addition to the description of the changes. What do you expect to be the effect of the change on usefulness or credibility of the simulation? If one were to compare results of the previous version with the new version for the same input conditions, what differences would you expect to see in the major output parameters of interest?

10. In briefings about software design or results, require a slide or two which describes efforts made by the engineer to determine that the conceptual design of the module meets the requirements, that the detailed design is consistent with the conceptual design, that the code actually implements the design, and that there are no coding errors.

11. Keep a file of things presented at team meetings. Include agenda, attendance list (maybe put all team members' names on the agenda as a standard practice and, on the copy of the agenda you throw in the file, pencil out the name of those who don't attend that particular meeting), viewgraph packages with notes about any reaction, discussion items, and decisions related to the viewgraphs.

12. Keep a library of the source materials that are referenced in documents about the simulation (design document and briefings, analyst's or user's manuals, etc.). At the very least keep a list of where to get them so that you can retrieve a copy if you need to.

13. It helps the team to be more consistent in following these practices if you do a couple of things:

a) Develop a template for briefings that includes place holders for the types of slides mentioned (title with name, date and contract information; assumptions slide; implications for model use; source of algorithms and embedded data; etc.)

b) Choose a meticulous person and put him or her in charge of taking notes during the meetings and keeping a file. Be kind to that person and reward him or her for doing this job for you.

c) The team lead needs to enforce following these practices. Reward people for doing this, and punish them if they don't (make them do it over till they include these things).

SUMMARY

JASA has supported a number of acquisition programs with cost-effective accreditation planning, application analysis to develop intended use statements and M&S acceptance criteria, V&V, and documentation. We have demonstrated that you almost never have to start from scratch: but you do have to document the results of V&V efforts that you're already doing so that an accreditation decision can be well substantiated. Informal documentation can be just as effective as formal reporting standards, as long as the documents are retrievable, accessible, and meet the needs of the accreditation authority. When it comes time to accredit M&S, why not get credit for what you're already doing, especially if you can do so for almost no cost and very little effort?

BIOGRAPHY

Michelle L. Kilikauskas is the Director of the Joint Accreditation Support Activity (JASA) at the Naval Air Warfare Center, Weapons Division (NAWCWD) at China Lake, California. She has served as the accreditation support agent for several international missile and military aircraft acquisition programs and was a participant in the International Test and Evaluation Steering Committee's Working Group of Experts on Verification and Validation. Ms. Kilikauskas is a frequent writer, speaker and teacher on the practical implementation of VV&A policy, principles and methodology.

David H. Hall is the Manager of SURVICE Engineering Company's Ridgecrest Area Operation, under contract to the NAWCWD Survivability Division for analysis support services. Prior to his retirement from the Government in January 2002, he was the Chief Analyst of the NAWCWD Survivability Division, head of the Survivability Analysis Branches, and interim JASA Director. From 1992 through 1996 he was also the Joint Project Manager of the Susceptibility Model Assessment and Range Test (SMART) project, which developed and demonstrated Joint M&S VV&A and configuration management processes for DOD. At SURVICE he continues to participate in JASA VV&A support services to DOD systems acquisition programs. He is a frequent speaker, author and instructor on survivability and M&S VV&A.